

**What is claimed is:**

1. An adsorbing material (1), especially for  
producing protective materials, comprising an  
5 especially sheetlike carrier material (2), an at  
least essentially air impervious, water vapor  
pervious barrier layer (3) and an adsorbing layer  
(4), wherein the barrier layer (3) is atop the  
carrier material (2) and also serves as a bonding  
10 layer for the adsorbing layer (4) disposed on that  
side of the barrier layer (3) which is remote from  
the carrier material (2),  
characterized in that  
the barrier layer (3) has a 25°C water vapor  
15 transmission rate of at least 20 l/m<sup>2</sup> per 24 h  
when 50 µm thick.
2. The adsorbing material according to claim 1 which  
is characterized in that the carrier material (2)  
20 is a preferably air pervious textile material,  
especially a textile fabric, especially wherein  
the textile material can be a woven, loop-  
formingly knitted, loop-drawingly knitted,  
nonwoven-scrim or bonded-fiber fabric, especially  
25 wherein the bonded-fiber fabric may be a batt.
3. The adsorbing material according to claim 1 or 2  
which is characterized in that the carrier  
material (2) is oleophobicized, especially by a  
30 specific impregnation, and/or in that the carrier  
material (2) has a basis weight in the range from  
50 to 300 g/m<sup>2</sup>, especially in the range from 75 to  
250 g/m<sup>2</sup> and preferably in the range from 90 to  
175 g/m<sup>2</sup>, and/or in that the carrier material (2)  
35 is an air pervious textile fabric which has a  
basis weight in the range from 75 to 250 g/m<sup>2</sup> and  
preferably in the range from 90 to 175 g/m<sup>2</sup> and  
may be finished to be oleophobic.

4. The adsorbing material according to any one of the preceding claims which is characterized in that the barrier layer (3) forms a continuous, uninterrupted layer on the carrier material (2) and/or in that the thickness of the barrier layer (3) is in the range from 1 to 1000  $\mu\text{m}$ , especially in the range from 1 to 500  $\mu\text{m}$ , preferably in the range from 5 to 250  $\mu\text{m}$ , more preferably in the range from 10 to 150  $\mu\text{m}$ , even more preferably in the range from 10 to 100  $\mu\text{m}$  and most preferably in the range from 20 to 50  $\mu\text{m}$  and/or in that the barrier layer (3) is applied in amounts from 1 to 250  $\text{g}/\text{m}^2$ , especially 10 to 150  $\text{g}/\text{m}^2$ , preferably 20 to 100  $\text{g}/\text{m}^2$  and more preferably 25 to 60  $\text{g}/\text{m}^2$ , based on the dry weight of the barrier layer (3).
5. An adsorbing material according to any one of the preceding claims which is characterized in that the barrier layer (3) is only minimally swellable if at all, especially wherein the swellability and/or the water uptake capacity of the barrier layer (3) is not more than 35%, especially not more than 25% and preferably not more than 20%, based on the own weight of the barrier layer (3), and/or in that the barrier layer (3) is at least essentially impervious to liquids, especially water, and/or to aerosols or at least retards their passage and/or in that the barrier layer (3) is essentially impervious to chemical poisons and warfare agents, especially contact poisons, or at least retards their passage.
6. The adsorbing material according to any one of the preceding claims which is characterized in that the barrier layer (3) has no or essentially no strongly hydrophilic groups, especially no hydroxyl groups, and/or in that the barrier layer (3) has weakly hydrophilic groups, especially polyether groups.

7. The adsorbing material according to any one of the preceding claims, which is characterized in that the barrier layer (3) comprises and/or consists of a plastic and/or a polymer, especially wherein the plastic and/or the polymer may be selected from the group of polyurethanes, polyetheramides, polyesteramides and/or cellulose-based polymers or derivatives of the aforementioned compounds, especially from cellulose-based polymers and polyurethanes, preferably from polyurethanes, and/or especially wherein the plastic and/or the polymer may comprise long-chain alkyl and/or alkoxy chains in its basic structure.
8. The adsorbing material according to any one of the preceding claims which is characterized in that the barrier layer (3) is obtained as a reaction product from the reaction of an isocyanate, especially of a masked or blocked isocyanate, with an isocyanate-reactive crosslinker; especially wherein the isocyanate may be di- or polyisocyanate; and/or especially wherein the isocyanate may be an especially blocked or masked NCO prepolymer having one or more urethane groups, especially wherein the NCO prepolymer has a number average molecular weight in the range from 2000 to 10 000 and especially in the range from 3500 to 7000 and/or the NCO prepolymer has an NCO group content in the range from 0.5% to 5% by weight, based on the NCO prepolymer, and/or the NCO prepolymer has an alkoxy and especially ethoxy group content in the range from 2% to 50% by weight and especially in the range from 5% to 25% by weight, based on the NCO prepolymer, preferably having sequence lengths in the range from 3 to 50, and/or the NCO prepolymer has an ionic group content in the range from 5 to 30 meq (milliequivalents) and especially

- in the range from 10 to 20 meq, based on 100 g of the NCO prepolymer; and/or especially wherein the isocyanate-reactive crosslinker may be a di- or polyol and/or a di- or polyamine, especially a di- or polyamine having aliphatically and/or cycloaliphatically primary and/or secondary amino groups, such as 4,4'-diaminodicyclohexylmethane; and/or especially wherein the mixing ratio of blocked or masked isocyanate to isocyanate-reactive crosslinker, reckoned as equivalent ratio of blocked NCO groups to isocyanate-reactive groups, may be in the range from 1:0.9 to 1:1.2.
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- 15 9. The adsorbing material according to claim 8 which is characterized in that the barrier layer (3) is obtained from a dispersion as described in EP 0 784 097 A1.
- 20 10. The adsorbing material according to any one of the preceding claims which is characterized in that the barrier layer (3) is formed as a multilayered laminate and/or as a multilayered composite, especially wherein the laminate and/or the composite consists of at least two and preferably at least three interconnected layers or plies.
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- 30 11. The adsorbing material according to claim 10 which is characterized in that the laminate or composite comprises a core layer based on a cellulose-based polymer and two outer layers which are connected to the core layer and are especially based on a polyurethane, especially as defined in claims 8 and 9, on a polyetheramide and/or on a polyester-amide, especially wherein the core layer may be formed on the basis of a cellulose-based polymer as a membrane 1 to 100  $\mu\text{m}$ , especially 5 to 50  $\mu\text{m}$  and preferably 10 to 20  $\mu\text{m}$  in thickness and/or especially wherein the outer layers connected to
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the core layer may each be formed as a membrane 1 to 100  $\mu\text{m}$ , especially 5 to 50  $\mu\text{m}$  and preferably 5 to 10  $\mu\text{m}$  in thickness.

- 5 12. The adsorbing material according to claim 10 or 11 which is characterized in that the laminate or composite comprises a core layer based on a polymer based on a polyurethane, especially as defined in claims 8 and 9, and two outer layers  
10 which are connected to the core layer and based on a polyurethane, especially as defined in claims 8 and 9.
- 15 13. The adsorbing material according to any of the preceding claims which is characterized in that the adsorbing layer (4) consists of discrete activated carbon particles, preferably in granular form ("granulocarbon") or spherical form ("sphero-carbon"), especially wherein the measure of  
20 central tendency diameter of the activated carbon particles is especially  $<0.5\text{ mm}$ , preferably  $<0.4\text{ mm}$ , more preferably  $<0.35\text{ mm}$ , even more preferably  $<0.3\text{ mm}$  and most preferably  $\leq 0.25\text{ mm}$  and/or the measure of central tendency diameter of the  
25 activated carbon particles is at least  $0.1\text{ mm}$  and/or especially wherein the adsorbing material (1) includes the activated carbon particles in an amount from 5 to  $500\text{ g/m}^2$ , especially 10 to  $400\text{ g/m}^2$ , preferably 20 to  $300\text{ g/m}^2$ , more preferably 25  
30 to  $250\text{ g/m}^2$ , even more preferably 50 to  $150\text{ g/m}^2$  and most preferably 50 to  $100\text{ g/m}^2$ , and/or especially wherein the activated carbon particles have an internal surface area (BET) of at least  $800\text{ g/m}^2$ , especially of at least  $900\text{ g/m}^2$ ,  
35 preferably at least  $1000\text{ g/m}^2$  and more preferably in the range from 800 to  $1500\text{ g/m}^2$ .

14. The adsorbing material according to any one of the preceding claims which is characterized in that the adsorbing layer (4) comprises activated carbon fibers, especially in the form of an activated carbon fabric, especially wherein the activated carbon fabric has a basis weight in the range from 20 to 200 g/m<sup>2</sup>, especially in the range from 30 to 150 g/m<sup>2</sup> and preferably in the range from 50 to 120 g/m<sup>2</sup>, and/or especially wherein the activated carbon fabric is a woven, loop-formingly knitted, nonwoven-scrim or bonded-fiber activated carbon fabric, especially on the basis of carbonized and activated cellulose and/or of a carbonized and activated acrylonitrile.
15. The adsorbing material according to any one of the preceding claims which is characterized in that the adsorbing layer (4) is additionally impregnated with at least one catalyst, especially wherein the catalyst used comprises enzymes and/or metal ions, preferably copper, silver, cadmium, platinum, palladium, zinc and/or mercury ions, and/or the amount of catalyst is in the range from 0.05% to 12% by weight, preferably in the range from 1% to 10% by weight and more preferably in the range from 2% to 8% by weight, based on the weight of the adsorbing layer (4).
16. The adsorbing material according to any one of the preceding claims which is characterized in that the proportion of the adsorbing layer (4) which is freely accessible for poisons and warfare agents to be adsorbed is at least 50%, especially at least 60% and preferably at least 70%, and/or the proportion of the adsorbing layer (4) which is covered by the barrier layer (3) is not more than 50%, especially not more than 40% and preferably not more than 30%.

17. The adsorbing material according to any one of the preceding claims which is characterized in that the adsorbing material (1) further comprises a covering layer (5) atop the adsorbing layer (4), especially wherein the covering layer (5) is secured to the adsorbing layer, especially by means of an adhesive which is preferably applied discontinuously and more preferably spotwise on the covering layer (5), or by means of a hotmelt web, and/or especially wherein the covering layer (5) is a preferably air pervious textile material, especially a textile fabric, preferably a woven, loop-formingly knitted, loop-drawingly knitted, nonwoven-scrim or bonded-fiber fabric, such as a batt for example, especially a polyamide/polyester (PA/PES) batt, and/or especially wherein the covering material (5) is abrasion resistant and especially consists of an abrasion-resistant textile material and/or wherein the covering material (5) has a basis weight in the range from 5 to 75 g/m<sup>2</sup>, especially in the range from 10 to 50 g/m<sup>2</sup> and preferably in the range from 15 to 30 g/m<sup>2</sup>.
18. An adsorbing material (1), especially according to any one of the preceding claims, comprising an especially sheetlike carrier material (2), an at least essentially air impervious, water vapor pervious barrier layer (3) and an adsorbing layer (4), wherein the barrier layer (3) is atop the carrier material (2) and also serves as a bonding layer for the adsorbing layer (4) disposed on that side of the barrier layer (3) which is remote from the carrier material (2), characterized in that the adsorbing material (1) has a 25°C water vapor transmission rate of at least 10 l/m<sup>2</sup> per 24 h, especially 15 l/m<sup>2</sup> per 24 h and preferably at least 20 l/m<sup>2</sup> per 24 h when the barrier layer (3) is 50 µm thick.

19. An adsorbing material (1), especially according to any one of the preceding claims, comprising an especially sheetlike carrier material (2), an at least essentially air impervious, water vapor pervious barrier layer (3) and an adsorbing layer (4), wherein the barrier layer (3) is atop the carrier material (2) and also serves as a bonding layer for the adsorbing layer (4) disposed on that side of the barrier layer (3) which is remote from the carrier material (2), characterized in that the adsorbing material (1) has a steady state water vapor transmission resistance  $R_{et}$ , measured according to DIN EN 31 092: 1993 (February 1994) and ISO 11 092, at 35°C of not more than 30 ( $m^2 \cdot pascal$ )/watt, especially not more than 25 ( $m^2 \cdot pascal$ )/watt, and preferably not more than 20 ( $m^2 \cdot pascal$ )/watt, when the barrier layer (3) is 50  $\mu m$  in thickness, and/or in that the barrier layer (3) has a steady state water vapor transmission resistance  $R_{et}$ , measured according to DIN EN 31 092: 1993 (February 1994) and ISO 11 092, at 35°C of not more than 25 ( $m^2 \cdot pascal$ )/watt, especially not more than 20 ( $m^2 \cdot pascal$ )/watt, and preferably not more than 13 ( $m^2 \cdot pascal$ )/watt, when 50  $\mu m$  in thickness.
20. An adsorbing material (1), especially according to any one of the preceding claims, comprising an especially sheetlike carrier material (2), an at least essentially air impervious, water vapor pervious barrier layer (3) and an adsorbing layer (4), wherein the barrier layer (3) is atop the carrier material (2) and also serves as a bonding layer for the adsorbing layer (4) disposed on that side of the barrier layer (3) which is remote from the carrier material (2), characterized in that the adsorbing material (1) offers permeation resistance to chemical warfare agents, especially bis[2-chloroethyl] sulfide (mustard gas, Hd,



Yellow Cross, measured according to CRDC-SP-84010, method 2.2, allowing not more than 4  $\mu\text{g}/\text{cm}^2$  per 24 h, especially not more than 3.5  $\mu\text{g}/\text{cm}^2$  per 24 h, preferably not more than 3.0  $\mu\text{g}/\text{cm}^2$  per 24 h and more preferably not more than 2.5  $\mu\text{g}/\text{cm}^2$  per 24 h when the barrier layer (3) is 50  $\mu\text{m}$  in thickness.

21. An adsorbing material (1), especially for producing protective materials, comprising an especially sheetlike carrier material (2), an at least essentially air impervious, water vapor pervious barrier layer (3) and an adsorbing layer (4), wherein the barrier layer (3) is atop the carrier material (2) and also serves as a bonding layer for the adsorbing layer (4) disposed on that side of the barrier layer (3) which is remote from the carrier material (2), characterized in that the barrier layer (3) is formed as a multilayered laminate and/or as a multilayered composite, especially as a laminate and/or composite consisting of at least two and preferably at least three interconnected layers or plies.
22. The adsorbing material according to claim 21 which is characterized in that the laminate or composite comprises a core layer and two outer layers connected to the core layer, especially wherein the core layer is formed on the basis of a cellulose- or polyurethane-based polymer and/or the two outer layers connected to the core layer are formed on the basis of a polyurethane-, polyetheramide- and/or polyesteramide-based polymer, preferably on the basis of a polyurethane, especially as defined in claims 8 and 9.
23. The adsorbing material according to claim 22 which is characterized in that the core layer, especially on the basis of a cellulose- or

polyurethane-based polymer, is formed as a membrane 1 to 100  $\mu\text{m}$ , especially 5 to 50  $\mu\text{m}$  and preferably 10 to 20  $\mu\text{m}$  in thickness, and/or in that the two outer layers connected to the core layer, especially on the basis of a polyurethane-,  
5 polyetheramide- and/or polyesteramide-based polymer, preferably on the basis of a polyurethane, are each formed as a membrane 1 to 100  $\mu\text{m}$ , especially 5 to 50  $\mu\text{m}$  and preferably 5 to  
10 10  $\mu\text{m}$  in thickness.

24. The adsorbing material according to any one of claims 21 to 23 which is characterized in that the barrier layer (3) has a 25°C water vapor  
15 transmission rate of at least 20  $\text{l/m}^2$  per 24 h when 50  $\mu\text{m}$  in thickness and/or in that the adsorbing material (1) has a 25°C water vapor transmission rate of at least 10  $\text{l/m}^2$  per 24 h, especially at least 15  $\text{l/m}^2$  per 24 h and  
20 preferably at least 20  $\text{l/m}^2$  per 24 h when the barrier layer (3) is 50  $\mu\text{m}$  in thickness.

25. The adsorbing material according to any one of claims 21 to 24, which is characterized by the features of the characterizing portion of one or  
25 more of claims 1 to 20.

26. A process for producing an adsorbing material according to any one of claims 1 to 25,  
30 characterized by the following steps:

- (a) providing a carrier material (2) as defined in claims 1 to 3 and 21, especially in continuous sheet form; then
- (b) applying a preferably aqueous dispersion  
35 comprising an isocyanate and an isocyanate-reactive crosslinker as defined in claims 8 and 9 to the carrier material (2), especially by spraying, doctor coating or the like and in amounts as defined in claim 4; then

- (c) predrying the dispersion applied in step (b), especially until the water is removed, wherein the predrying temperatures are especially below the crosslinking temperature of the dispersion and preferably amount to about 80°C to 120°C and more preferably about 100°C, to form a continuous, uninterrupted tacky layer or film which also serves as a bonding layer for the adsorbing layer (4) to be applied in subsequent step (d); then
- (d) applying the adsorbing layer (4) as defined in claims 1 and 13 to 16 to the still tacky bonding layer generated in step (c), especially in amounts as defined in claims 13 and 14; then
- (e) crosslinking the still tacky bonding layer by heating to above the crosslinking temperature, preferably at temperatures of 140 to 180°C or more, to form a barrier layer (3) as defined in claims 1, 4 to 12 and 18 to 25, supporting the adsorbing layer (4) applied thereto; then
- (f) optionally applying a covering material (5) as defined in claim 17 to the adsorbing layer (4), especially wherein the dispersion used in step (b) is a dispersion as described in EP 0 784 097 A1 and/or especially wherein the steps (e) and (f) are carried out concurrently, in which case the crosslinking of the still tacky bonding layer can take place together with the thermal lamination thereto of the covering material (5), and/or especially the adsorbing layer (4) comprises an activated carbon fabric as defined in claim 14 which is pressed onto or into the predried, still tacky bonding layer in step (d), and/or especially wherein the covering material (5) is thermally laminated in place in step (f) by means of a hotmelt web or imprinted hotmelt dots.

27. A process for producing an adsorbing material according to any one of claims 1 to 25, characterized by the following steps:

- 5 (a) providing a carrier material (2) as defined in claims 1 to 3 and 21, especially in continuous sheet form; then
- 10 (b) applying a preferably aqueous dispersion comprising an isocyanate and an isocyanate-reactive crosslinker as defined in claims 8 and 9 to the carrier material (2), especially by spraying, doctor coating or the like and in amounts as defined in claim 4; then
- 15 (c) applying the adsorbing layer (4) as defined in claims 1 and 13 to 16 to the layer of the dispersion applied in step (b), especially in amounts as defined in claims 13 and 14; then
- (d) drying the layer of dispersion applied in step (b), with or without crosslinking; then
- 20 (e) optionally applying a covering material (5) as defined in claim 17 to the adsorbing layer (4),

especially wherein the dispersion used in step (b) is a dispersion as described in EP 0 784 097 A1 and/or especially wherein the steps (d) and (e) are carried out concurrently, in which case the drying and crosslinking of the layer of the dispersion applied in step (b) can take place with the thermal lamination thereto of the covering material (5), and/or especially wherein the covering material (5) is thermally laminated in place in step (e) by means of a hotmelt web or imprinted hotmelt dots.

28. A process for producing an adsorbing material according to any one of claims 1 to 25, characterized by the following steps:

- 35 (a) providing a carrier material (2) as defined in claims 1 to 3 and 21, especially in continuous sheet form; then

- 5 (b) applying a preferably aqueous dispersion comprising an isocyanate and an isocyanate-reactive crosslinker as defined in claims 8 and 9 to the carrier material (2), especially by spraying, doctor coating or the like and in amounts as defined in claim 4; then
- 10 (c) predrying the dispersion applied in step (b), especially until the water is removed, wherein the predrying temperatures are especially below the crosslinking temperature of the dispersion and preferably amount to about 80°C to 120°C and more preferably about 100°C, to form a continuous, uninterrupted tacky layer or film which also serves as a bonding layer for the layer and/or membrane based on a cellulose-based polymer as defined in claims 7, 10, 11, 22 and 23 to be applied in subsequent step (d); then
- 15 (d) applying a layer and/or membrane based on a cellulose-based polymer as defined in claims 7, 10, 22 and 23 to the still tacky bonding layer generated in step (c); then
- 20 (e) applying a preferably aqueous dispersion comprising an isocyanate and an isocyanate-reactive crosslinker as defined in claims 8 and 9 to the step (d) applied layer and/or membrane based on a cellulose-based polymer, especially by spraying, doctor coating or the like and in amounts as defined in claim 4; then
- 25 (f) optionally predrying the dispersions applied in step (b), especially until the water is removed, wherein the predrying temperatures are especially below the crosslinking temperature of the dispersion and preferably amount to about 80°C to 120°C and more preferably about 100°C, to form a continuous, uninterrupted tacky layer or film which also serves as a bonding layer for the adsorbing
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layer (4) to be applied in subsequent step (g); then

(g) applying the adsorbing layer (4) as defined in claims 1 and 13 to 16 to the step (e) applied layer, consisting of the dispersion, or else to the step (f) generated, still tacky bonding layer, especially in amounts as defined in claims 13 and 14; then

(h) drying and/or crosslinking the dispersion or the still tacky bonding layer by heating to above the crosslinking temperature, preferably at temperatures of 140 to 180°C or more, to form a barrier layer (3) as defined in claims 1, 4 to 12 and 18 to 25 supporting the adsorbing layer (4) applied thereto; then

(i) optionally applying a covering material (5) as defined in claim 17 to the adsorbing layer (4), especially wherein step (i) may be carried out together with step (h).

29. A process for producing an adsorbing material according to any one of claims 1 to 25, characterized by the following steps:

(a) providing a release layer, especially in the form of a preferably siliconized or waxed release paper; then

(b) applying a preferably aqueous dispersion comprising isocyanate and an isocyanate-reactive crosslinker as defined in claims 8 and 9 to the release layer, especially by spraying, doctor coating and the like and in amounts as defined in claim 4; then

(c) predrying the step (b) applied layer, consisting of the dispersion, especially until the water is removed, with or without crosslinking; then

(d) renewedly applying a preferably aqueous dispersion comprising an isocyanate and an isocyanate-reactive crosslinker as defined in

- claims 8 and 9 to the step (c) produced, dried and optionally crosslinked layer, especially by spraying, doctor coating and the like and in amounts as defined in claim 4; then
- 5 (e) optionally predrying the step (d) produced second layer especially until the water is removed, and applying a carrier material (2) as defined in claims 1 to 3 and 21,
- 10 especially in continuous sheet form, to the second layer obtained in step (d); then
- (f) optionally predrying the step (d) applied second layer, especially until the water is removed, with or without crosslinking; then
- 15 (g) removing the release layer; then
- (h) renewedly applying a preferably aqueous dispersion comprising isocyanate and an isocyanate-reactive crosslinker as defined in claims 8 and 9 to that side of the dried and
- 20 optionally crosslinked layer obtained in step (c) that was previously covered with the release layer, especially by spraying, doctor coating or the like and in amounts as defined in claim 4; then
- 25 (i) optionally predrying the dispersions applied in step (h), especially until the water is removed, the predrying temperatures being especially below the crosslinking temperature of the dispersion and preferably amounting to
- 30 about 80°C to 120°C and preferably about 100°C to form a continuous, uninterrupted tacky layer or film which also serves as bonding layer for the adsorbing layer (4) to be applied in subsequent step (j); then
- 35 (j) applying the adsorbing layer (4) as defined in claims 1 and 13 to 16 to the step (h) applied layer, consisting of the dispersion, or else to the step (i) generated, still tacky bonding layer, especially in amounts as

defined in claims 13 and 14; then

- 5 (k) drying and/or crosslinking the dispersion or the still tacky bonding layer by heating to above the crosslinking temperature, preferably at temperatures of 140 to 180°C or more to form a barrier layer (3) based on a laminate or composite of three interconnected polyurethane layers supporting the adsorbing layer (4) applied thereto; then
- 10 (l) optionally applying a covering material (5) as defined in claim 17 to the adsorbing layer (4), especially wherein step (k) may be carried out together with step (l)
- 15 30. The use of an adsorbing material (1) according to any one of claims 1 to 25 for producing protective materials of any kind, especially protective suits, protective gloves and protective covers, preferably for NBC deployment.
- 20 31. The use according to claim 30 which is characterized in that the carrier material (2) faces the source of harmful material.
- 25 32. Protective materials, especially protective suits, protective gloves and protective covers, produced using an adsorbing material (1) according to any one of claims 1 to 25 and/or comprising an adsorbing material (1) according to any one of
- 30 claims 1 to 25.
- 35 33. The protective materials according to claim 32 which are characterized in that the carrier material (2) faces the source of harmful material and/or in that they are protective suits wherein, when worn, the carrier material (2) is disposed on the body-remote side.